MULTIMEDIA UNIVERSITY

STUDENT IDENTIFICATION NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2 2022/2023

BSA1024 – STATISTICS

(All sections / Groups)

07 JULY 2023
9.00 a.m. - 11.00 a.m.
(2 hours)

INSTRUCTIONS TO STUDENTS

1. This question paper consists of **10 pages** including statistical formulas and statistical tables.

2. This question paper consists of **FOUR** structured questions. Attempt **ALL** questions.

3. Students are allowed to use non-programmable scientific calculators with no restrictions.

QUESTION 1 [25 Marks]

One of the keys in measuring the quality of service provided by an organization is the length of time taken in responding to customer complaints. A family-held department store had a business objective of improving its response to complaints.

The length of response time was defined as the number of days between the complaint was made and when it was resolved. Data were collected from 20 complaints that were made in the last year and the response time (day) were recorded as follows:

54	5	35	137	31	27	152	13	123	81
74	27	11	19	126	110	29	61	35	94

a) Compute the mean, median and standard deviation for the above data. [6 marks]

b) Using the values obtained in (a), compute the coefficient which measures the skewness of the data and interpret the value. [4 marks]

c) At 10% significance level, is there evidence that the average number of days taken to resolve the complaint received is more than 50 days?

[10 marks]

d) Construct a 95% confidence interval estimate for the population mean of days to resolve the complaint received.

[5 marks]

QUESTION 2 [25 Marks]

a) A financial analyst estimates that the probability that the economy will experience a recession in the following year is 36%. She also believes that if the economy encounters a recession, the probability that her mutual fund will increase in value is 25%. If there is no recession, the probability that the mutual fund will increase in value is 67%.

i. Draw a tree diagram for the situation above and state in detail probabilities at all branches. [5 marks]

ii. Find the probability that the mutual fund's value will increase. [3 marks]

iii. If the mutual fund's value has increased, what is the probability that the economy is in a recession? [3 marks]

Continued...

b) Automobiles arrive at the Damansara Toll plaza at the rate of three per minute. The distribution of arrivals approximates a Poisson distribution.

i. What is the probability that at least four automobiles arrive during a particular minute? [4 marks]

ii. What is the average number of automobile arrivals during half an hour? [2 marks]

c) A company pays its factory workers with average wage of RM13.50 per hour with a standard deviation of RM1.50. If the wages are approximately normally distributed,

i. find the probability that the factory workers receive wages less than RM85 for one-shift if they work for 7-hours per shift. [4 marks]

ii. what is the amount of wage per hour with only 10% of the workers receives greater than or equal to the amount? [4 marks]

QUESTION 3 [20 Marks]

a) A firm is considering to offer a housing allowance to its new-hire (young) executives. The aim of giving this allowance is to compensate for differences in the price of housing. However, a manager claims that the housing prices are lower for houses outside Klang Valley and the firm should only compensate young executives who live inside Klang Valley.

In investigating of his claim, the firm do a survey of typical starter home prices (in RM '000) for 10 young executives who live inside Klang Valley and another 10 of them who live outside Klang Valley. The survey data are as follows:

Inside					**Outside**				
169	206	188	198	144	167	135	178	185	146
324	248	199	171	172	155	154	157	178	191

At the 5% significance level, is there any evidence to support the manager's claim? [14 marks]

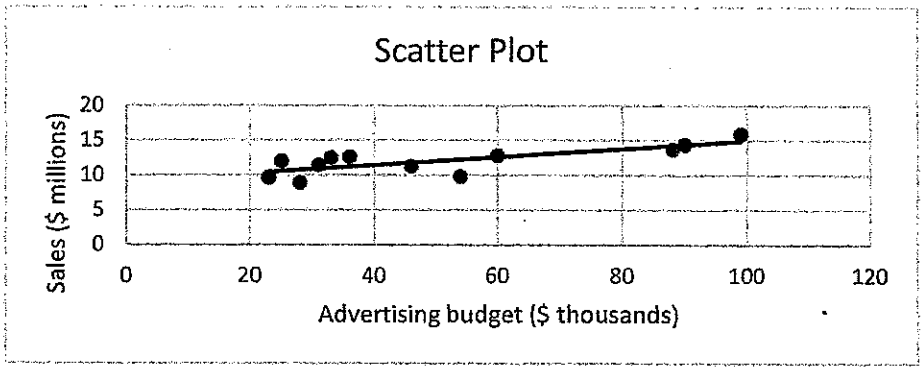
b) A study is investigating the cost of renting a midsize automobile in Langkawi per day. From the sample of 25 midsize automobiles, the mean cost was approximately RM110 per day with a standard deviation of RM12.50. Set up a 90% confidence interval estimate for the population mean daily rental cost for a midsize automobile in Langkawi. Interpret the interval estimate. [6 marks]

Continued...

QUESTION 4 [30 Marks]

a) An owner of a furniture store interested in examining the relationship between advertising and sales. He recorded the monthly advertising budget ($ thousands) and the monthly sales ($ millions) for a sample of 12 months to discover his interest. The scatterplot, regression output and data are generated as below:

Advertising ($ thousands)	Sales ($ millions)
23	9.6
46	11.3
60	12.8
54	9.8
28	8.9
33	12.5
25	12.0
31	11.4
36	12.6
88	13.7
90	14.4
99	15.9



SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.77882
R Square	X
Adjusted R Square	0.567216
Standard Error	1.346796
Observations	12

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	9.100374	0.851528	10.68711	8.62E-07
Advertising	0.058231	0.014831	3.926424	0.002837

Continued....

i. Based on the scatter plot above, describe the relationship between the monthly advertising budget and the furniture sales. [4 marks]

ii. Develop the estimated regression equation from the above regression output. [3 marks]

iii. Interpret the slope coefficient of monthly advertising budget affecting the total sales of furniture. [2 marks]

iv. Compute the coefficient of determination and interpret its meaning. [3 marks]

v. At the 5% level of significance, does the monthly advertising budget has significant influence on the total sales of furniture? [5 marks]

vi. Predict the total sales of furniture if the store spent $70,000 for advertising. Is this estimate reliable? Explain. [3 marks]

b) A table below is consisting selected consumer goods for 2012 and 2022:

Product	**2012**		**2022**	
	Price (RM)	Quantity	Price (RM)	Quantity
Food	340	115	345	90
Rent	600	16	600	13
Drinks	120	90	150	120
Transportation	250	43	260	56

Compute and interpret the Laspeyres Price Index (LPI) and Paashe Price Index (PPI) for 2022 using 2012 as the base period. [10 marks]

End of Question.

A. DESCRIPTIVE STATISTICS

Mean $(\bar{x}) = \frac{\sum_{i=1}^{n} X_i}{n}$

Standard Deviation $(s) = \sqrt{\frac{\sum_{i=1}^{n} X_i^2}{n-1} - \frac{(\sum_{i=1}^{n} X_i)^2}{n(n-1)}}$

Coefficient of Variation $(CV) = \frac{\sigma}{\overline{X}} \times 100$

Pearson's Coefficient of Skewness $(S_k) = \frac{3(\overline{X} - Median)}{s}$

B. PROBABILITY

P (A or B) = P (A) + P (B) – P (A and B)

P (A and B) = P (A)× P (B) if A and B are independent

P (A | B) = P (A and B) ÷ P (B)

Poisson Probability Distribution

If X follows a Poisson Distribution , $P(\lambda)$ where $P(X = x) = \frac{e^{-\lambda}\lambda^x}{x!}$

then the mean = $E(X) = \lambda$ and variance = $VAR(X) = \lambda$

Binomial Probability Distribution

If X follows a Binomial Distribution B(n, p) where $P(X = x) = {}^nC_x p^x q^{n-x}$

then the mean = $E(X) = np$ and variance = $VAR(X) = npq$ where $q = 1 - p$

Normal Distribution

If X follows a Normal distribution, $N(\mu, \sigma)$ where $E(X) = \mu$ and $VAR(X) = \sigma^2$

then $Z = \frac{X - \mu}{\sigma}$

C. EXPECTATION AND VARIANCE OPERATORS

$E(X) = \sum[X \bullet P(X)]$

$VAR(X) = E(X^2) - [E(X)]^2$ where $E(X^2) = \sum[X^2 \bullet P(X)]$

If $E(X) = \mu$ then $E(cX) = c\,\mu$, $E(X_1 + X_2) = E(X_1) + E(X_2)$

If $VAR(X) = \sigma^2$ then $VAR(cX) = c^2\,\sigma^2$, $VAR(X_1 + X_2) = VAR(X_1) + VAR(X_2) + 2\,COV(X_1, X_2)$

where $COV(X_1, X_2) = E(X_1 X_2) - [E(X_1)\,E(X_2)]$

D. CONFIDENCE INTERVAL ESTIMATION AND SAMPLE SIZE DETERMINATION

$(100-\alpha)$ % Confidence Interval for Population Mean (σ Known) = $\mu = \overline{X} \pm Z_{\alpha/2}\left(\sigma/\sqrt{n}\right)$ $(100-\alpha)$% Confidence Interval for Population Mean (σ Unknown) = $\mu = \overline{X} \pm t_{\alpha/2,n-1}\left(s/\sqrt{n}\right)$
$(100-\alpha)$% Confidence Interval for Population Proportion $= \hat{p} \pm Z_{\alpha/2}\sigma_{p^\wedge}$ Where $\sigma_{\hat{p}} = \sqrt{\frac{\hat{p}(1-\hat{p})}{n}}$
Sample Size Determination for Population Mean $= n \geq \left[\frac{(Z_{\alpha/2})\sigma}{E}\right]^2$ Sample Size Determination for Population Proportion $= n \geq \frac{(Z_{\alpha/2})^2\,\hat{p}(1-\hat{p})}{E^2}$ Where E = Limit of Error in Estimation

E. HYPOTHESIS TESTING

One Sample Mean Test	
Standard Deviation (σ) Known	**Standard Deviation (σ) Not Known**
$Z = \frac{\bar{x}-\mu}{\sigma/\sqrt{n}}$	$t = \frac{\bar{x}-\mu}{s/\sqrt{n}}$
One Sample Proportion Test	
$z = \frac{\hat{p}-p}{\sigma_p}$ where $\sigma_p = \sqrt{\frac{p(1-p)}{n}}$	

Two Sample Mean Test	
Standard Deviation (σ) Known	**Standard Deviation (σ) Not Known**
$z=\frac{(\overline{x}_1-\overline{x}_2)-(\mu_1-\mu_2)}{\sqrt{\sigma_1^2/n_1+\sigma_2^2/n_2}}$	$t=\frac{(\overline{x}_1-\overline{x}_2)-(\mu_1-\mu_2)}{\sqrt{S_p^2\left(1/n_1+1/n_2\right)}}$ where $S_p^2=\frac{(n_1-1)S_1^2+(n_2-1)S_2^2}{(n_1+n_2-2)}$

Two Sample Proportion Test

$$z=\frac{\hat{p}_1-\hat{p}_2}{\sqrt{p(1-p)\left(\frac{1}{n_1}+\frac{1}{n_2}\right)}}$$

where $p=\frac{X_1+X_2}{n_1+n_2}$

where X_1 and X_2 are the number of successes from each population

F. REGRESSION ANALYSIS

Simple Linear Regression

Population Model: $Y=\beta_0+\beta_1X_1+\varepsilon$

Sample Model: $\hat{y}=b_0+b_1x_1+e$

ANOVA Table for Regression

Source	Degrees of Freedom	Sum of Squares	Mean Squares
Regression	*1*	SSR	MSR = SSR/1
Error/Residual	$n-2$	SSE	MSE = SSE/$(n-2)$
Total	$n-1$	SST	

Test Statistic for Significance of the Predictor Variable

$t_i=\frac{b_i}{S_{b_i}}$ and the critical value $=\pm t_{\alpha/2,(n-p-1)}$

Where p= number of predictor

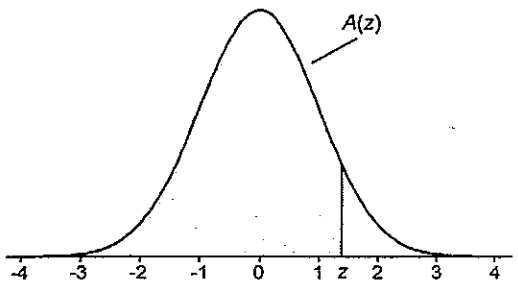
G. INDEX NUMBERS

Simple Price Index $P=\frac{p_t}{p_0}\times 100$	**Laspeyres Quantity Index** $P=\frac{\sum p_0 q_t}{\sum p_0 q_0}\times 100$
Aggregate Price Index $P=\frac{\sum p_t}{\sum p_0}(100)$	**Paasche Quantity Index** $P=\frac{\sum p_t q_t}{\sum p_t q_0}\times 100$
Laspeyres Price Index $P=\frac{\sum p_t q_0}{\sum p_0 q_0}\times 100$	**Fisher's Ideal Price Index** $\sqrt{(Laspeyres\ \ Price\ Index)(Paa\ sche\ Price\ Index)}$
Paasche Price Index $P=\frac{\sum p_t q_t}{\sum p_0 q_t}\times 100$	**Value Index** $V=\frac{\sum p_t q_t}{\sum p_0 q_0}\times 100$

STATISTICAL TABLES 1

TABLE A.1

Cumulative Standardized Normal Distribution



$A(z)$ is the integral of the standardized normal distribution from $-\infty$ to z (in other words, the area under the curve to the left of z). It gives the probability of a normal random variable not being more than z standard deviations above its mean. Values of z of particular importance:

z	$A(z)$	
1.645	0.9500	Lower limit of right 5% tail
1.960	0.9750	Lower limit of right 2.5% tail
2.326	0.9900	Lower limit of right 1% tail
2.576	0.9950	Lower limit of right 0.5% tail
3.090	0.9990	Lower limit of right 0.1% tail
3.291	0.9995	Lower limit of right 0.05% tail

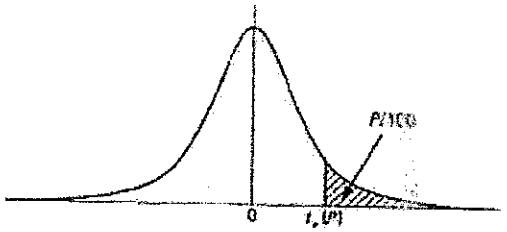
z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.0	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.5	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.6	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.8	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.9	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2.0	0.9772	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
2.1	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
2.2	0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.9890
2.3	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.4	0.9918	0.9920	0.9922	0.9925	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
2.5	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
2.6	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
2.7	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
2.8	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981
2.9	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986
3.0	0.9987	0.9987	0.9987	0.9988	0.9988	0.9989	0.9989	0.9989	0.9990	0.9990
3.1	0.9990	0.9991	0.9991	0.9991	0.9992	0.9992	0.9992	0.9992	0.9993	0.9993
3.2	0.9993	0.9993	0.9994	0.9994	0.9994	0.9994	0.9994	0.9995	0.9995	0.9995
3.3	0.9995	0.9995	0.9995	0.9996	0.9996	0.9996	0.9996	0.9996	0.9996	0.9997
3.4	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9998
3.5	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998
3.6	0.9998	0.9998	0.9999							

TABLE 10. PERCENTAGE POINTS OF THE t-DISTRIBUTION

This table gives percentage points $t_\nu(P)$ defined by the equation

$$\frac{P}{100} = \frac{1}{\sqrt{\nu\pi}} \frac{\Gamma(\frac{1}{2}\nu+\frac{1}{2})}{\Gamma(\frac{1}{2}\nu)} \int_{t_\nu(P)}^{\infty} \frac{dt}{(1+t^2/\nu)^{\frac{1}{2}(\nu+1)}}.$$

Let X_1 and X_2 be independent random variables having a normal distribution with zero mean and unit variance and a χ^2-distribution with ν degrees of freedom respectively; then $t = X_1/\sqrt{X_2/\nu}$ has Student's t-distribution with ν degrees of freedom, and the probability that $t \geqslant t_\nu(P)$ is $P/100$. The lower percentage points are given by symmetry as $-t_\nu(P)$, and the probability that $|t| \geqslant t_\nu(P)$ is $2P/100$.



The limiting distribution of t as ν tends to infinity is the normal distribution with zero mean and unit variance. When ν is large interpolation in ν should be harmonic.

P	40	30	25	20	15	10	5	2·5	1	0·5	0·1	0·05
$\nu = 1$	0·3249	0·7265	1·0000	1·3764	1·963	3·078	6·314	12·71	31·82	63·66	318·3	636·6
2	0·2887	0·6172	0·8165	1·0607	1·386	1·886	2·920	4·303	6·965	9·925	22·33	31·60
3	0·2767	0·5844	0·7649	0·9785	1·250	1·638	2·353	3·182	4·541	5·841	10·21	12·92
4	0·2707	0·5686	0·7407	0·9410	1·190	1·533	2·132	2·776	3·747	4·604	7·173	8·610
5	0·2672	0·5594	0·7267	0·9195	1·156	1·476	2·015	2·571	3·365	4·032	5·893	6·869
6	0·2648	0·5534	0·7176	0·9057	1·134	1·440	1·943	2·447	3·143	3·707	5·208	5·959
7	0·2632	0·5491	0·7111	0·8960	1·119	1·415	1·895	2·365	2·998	3·499	4·785	5·408
8	0·2619	0·5459	0·7064	0·8889	1·108	1·397	1·860	2·306	2·896	3·355	4·501	5·041
9	0·2610	0·5435	0·7027	0·8834	1·100	1·383	1·833	2·262	2·821	3·250	4·297	4·781
10	0·2602	0·5415	0·6998	0·8791	1·093	1·372	1·812	2·228	2·764	3·169	4·144	4·587
11	0·2596	0·5399	0·6974	0·8755	1·088	1·363	1·796	2·201	2·718	3·106	4·025	4·437
12	0·2590	0·5386	0·6955	0·8726	1·083	1·356	1·782	2·179	2·681	3·055	3·930	4·318
13	0·2586	0·5375	0·6938	0·8702	1·079	1·350	1·771	2·160	2·650	3·012	3·852	4·221
14	0·2582	0·5366	0·6924	0·8681	1·076	1·345	1·761	2·145	2·624	2·977	3·787	4·140
15	0·2579	0·5357	0·6912	0·8662	1·074	1·341	1·753	2·131	2·602	2·947	3·733	4·073
16	0·2576	0·5350	0·6901	0·8647	1·071	1·337	1·746	2·120	2·583	2·921	3·686	4·015
17	0·2573	0·5344	0·6892	0·8633	1·069	1·333	1·740	2·110	2·567	2·898	3·646	3·965
18	0·2571	0·5338	0·6884	0·8620	1·067	1·330	1·734	2·101	2·552	2·878	3·610	3·922
19	0·2569	0·5333	0·6876	0·8610	1·066	1·328	1·729	2·093	2·539	2·861	3·579	3·883
20	0·2567	0·5329	0·6870	0·8600	1·064	1·325	1·725	2·086	2·528	2·845	3·552	3·850
21	0·2566	0·5325	0·6864	0·8591	1·063	1·323	1·721	2·080	2·518	2·831	3·527	3·819
22	0·2564	0·5321	0·6858	0·8583	1·061	1·321	1·717	2·074	2·508	2·819	3·505	3·792
23	0·2563	0·5317	0·6853	0·8575	1·060	1·319	1·714	2·069	2·500	2·807	3·485	3·768
24	0·2562	0·5314	0·6848	0·8569	1·059	1·318	1·711	2·064	2·492	2·797	3·467	3·745
25	0·2561	0·5312	0·6844	0·8562	1·058	1·316	1·708	2·060	2·485	2·787	3·450	3·725
26	0·2560	0·5309	0·6840	0·8557	1·058	1·315	1·706	2·056	2·479	2·779	3·435	3·707
27	0·2559	0·5306	0·6837	0·8551	1·057	1·314	1·703	2·052	2·473	2·771	3·421	3·690
28	0·2558	0·5304	0·6834	0·8546	1·056	1·313	1·701	2·048	2·467	2·763	3·408	3·674
29	0·2557	0·5302	0·6830	0·8542	1·055	1·311	1·699	2·045	2·462	2·756	3·396	3·659
30	0·2556	0·5300	0·6828	0·8538	1·055	1·310	1·697	2·042	2·457	2·750	3·385	3·646
32	0·2555	0·5297	0·6822	0·8530	1·054	1·309	1·694	2·037	2·449	2·738	3·365	3·622
34	0·2553	0·5294	0·6818	0·8523	1·052	1·307	1·691	2·032	2·441	2·728	3·348	3·601
36	0·2552	0·5291	0·6814	0·8517	1·052	1·306	1·688	2·028	2·434	2·719	3·333	3·582
38	0·2551	0·5288	0·6810	0·8512	1·051	1·304	1·686	2·024	2·429	2·712	3·319	3·566
40	0·2550	0·5286	0·6807	0·8507	1·050	1·303	1·684	2·021	2·423	2·704	3·307	3·551
50	0·2547	0·5278	0·6794	0·8489	1·047	1·299	1·676	2·009	2·403	2·678	3·261	3·496
60	0·2545	0·5272	0·6786	0·8477	1·045	1·296	1·671	2·000	2·390	2·660	3·232	3·460
120	0·2539	0·5258	0·6765	0·8446	1·041	1·289	1·658	1·980	2·358	2·617	3·160	3·373
∞	0·2533	0·5244	0·6745	0·8416	1·036	1·282	1·645	1·960	2·326	2·576	3·090	3·291

End of Paper.